

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

LEE, Young-Pil

The Cheonghwa Bldg. 1571-18 Seocho-dong, Seocho-gu
Seoul 137-874, Republic of Korea

PCT

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

(PCT Rule 43bis.1)

Date of mailing
(day/month/year) **20 OCTOBER 2004 (20.10.2004)**

Applicant's or agent's file reference
PH-21689-PCT

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/KR2004/001651

International filing date (day/month/year)
05 JULY 2004 (05.07.2004)

Priority date(day/month/year)
05 JULY 2003 (05.07.2003)

International Patent Classification (IPC) or both national classification and IPC
IPC7 C07D 487/22

Applicant

POSTECH FOUNDATION et al

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/KR



Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

JUNG, YOUNG JA

Telephone No. 82-42-481-8164



**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/KR2004/001651

Box No. 1 Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

- ☐ a sequence listing
☐ table(s) related to the sequence listing

b. format of material

- ☐ in written format
☐ in computer readable form

c. time of filing/furnishing

- ☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

BEST AVAILABLE COPY

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/KR2004/001651

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-9	YES
	Claims		NO
Inventive step (IS)	Claims	1-9	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-9	YES
	Claims		NO

2. Citations and explanations :

The present invention relates to a solid substrate for a biochip having a uniform spacing of predetermined functional groups and a biochip using the same. More particularly, the present invention relates to a rotaxane compound, a rotaxane compound-bonded solid substrate, and a biochip using the solid substrate.

1. Prior Art

The following documents from the PCT International Search Report have been considered for the purpose of this report:

(D1) Hee-Joon Kim, et al., PNAS, Vol. 99, No. 8, (2002), p5007-5011

(D2) Eunsung Lee, et al., Angew. Chem. Int. Ed., Vol. 40, No. 2, (2001), p 399-4402

(D3) Yong-beom Lim, et al., Bioconjugate chem. Vol. 13, No. 6, (2002), p 1181-1185

(D4) Sang Yong Jon, et al., J. Am. Chem. Soc., Vol. 125, No. 34, (2003), p 10186-10187

(D5) Haizhen Zhang, et al., J. Am. Chem. Soc. Vol. 125, No. 31, (2003), p 9284-9285

D1 discloses the inclusion behavior of methylviologen (N,N'-dimethyl-4,4'-bipyridinium, MV) dication in cucurbit[7]uril (CB[7]) by using various spectroscopic and electrochemical methods. The inclusion complex of MV dication in CB[7] is stable thermodynamically and kinetically and this provides an insight to the design of novel molecular devices such as electrochemically controllable molecular machines.

D2 discloses the synthesis of a novel 2D polyrotaxane with large cavities and channels which demonstrates that this is indeed a viable to modular porous solids.

(Continued in the Supplemental Box.)

BEST AVAILABLE COPY

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/KR2004/001651

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of :

Box V

D3 discloses that a ternary complex of PPI-DAB dendrimer [(1,4-diaminobutane); Gen = N; dendri-poly(propyleneimine); - [NHC(=O)CH(2)NH(2)(+)(CH(2)X(4)NH(3X+))](zX)], DNA, and cucurbituril(CB) is evaluated as an example of a totally self-assembled gene delivery carrier and the complex is formed in a noncovalent way in which DNA interacts with PPI-DAB electrostatically and CB with PPI-DAB through multiple noncovalent interactions.

D4 relates to a facile synthesis of cucurbit[n]uril derivatives via direct functionalization and expanded utilization of cucurbit[n]uril. A CB[6] modified surface may be useful in designing sensors and biochips and CB[n] can be attached on silica surfaces which can be utilized as a stationary phase in chromatography.

D5 discloses the electrospray ionization mass spectrometric experiments which demonstrate that cucurbit[6]uril pseudorotaxanes survive into the gas phase and exhibit dissociation and reactivity distinct from that of nonrotaxanes.

2. Novelty

None of the prior art documents describe a compound represented by Formula 1 in which a compound of Formula 3 vertically passes through a cavity of cucurbituril or its derivative of Formula 2 and a solid substrate bonded with the compound and a biochip including the solid substrate. Therefore, the subject-matter of claims 1-9 can be regarded as novel under PCT Article 33(2)

3. Inventive Step

According to the present invention, a rotaxane compound is used to separate molecules within a linkage layer formed on a solid substrate of a biochip by a predetermined distance. A rotaxane compound is introduced in a linkage layer, the spacing between adjacent linear compounds can be maintained at more than a diameter of cucurbituril, a linkage layer made of a rotaxane compound is formed on a solid substrate, and molecules which constitute the linkage layer can be spaced apart from each other by a predetermined distance.

The rotaxane compound of Formula 1 can be bonded to a modified solid substrate with various end functional groups to form a desired solid substrate and this substrate bonded with the rotaxane compound of Formula 1 can be used in preparation of a gene chip. Therefore, a rotaxane compound of the present invention allows the uniform spacing between rotaxane molecules within a linkage layer formed on a solid substrate and a biochip with selectivity and sensitivity can be produced.

Since the present invention is considered as being non-obvious to a person skilled in the art, and consequently an inventive step can be acknowledged for the subject-matter of claims 1 to 9 under PCT Article 33(3)

4. Industrial Applicability

The subject-matter of claims 1 to 9 is considered to be industrially applicable under PCT Article 33(4).

BEST AVAILABLE COPY